AMPLIFICATION OF INTERAURAL LEVEL DIFFERENCES IMPROVES SOUND LOCALIZATION IN ACOUSTIC SIMULATIONS OF BIMODAL HEARING

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While users of a cochlear implant (CI) and a contralateral hearing aid (HA) are sensitive to interaural level differences (ILDs) [1] and interaural time differences (ITD) [2], they exhibit poor sound source localization performance. One of the main reasons is that while ILD cues are physically large at high frequencies, most of these subjects only have residual acoustic hearing in the low frequencies. Another reason is that modification of the CI and HA signal processing to allow ITD perception with clinical devices is still under investigation, and even with experimental devices, a minimum level of residual hearing is necessary to allow ITD perception [2]. Therefore, when using their clinical speech processor and hearing aid, most of these subjects cannot optimally use ILD or ITD cues for localization in the horizontal plane.

Perception of ILD cues can be enabled by “transposing” the available cues from high frequencies to lower frequencies that can be perceived acoustically, or by even further amplifying the cues to compensate for the lack of perceptible ITD cues. Both the CI speech processor and the hearing aid have a microphone that records the full band acoustic signals at the two ears. Therefore, a signal processing system can determine the ILD (or sound source location) from the full band signals and introduce it in the low frequencies in the two devices.

We developed such an ILD introduction algorithm and evaluated it with six normal hearing subjects using noise band vocoder CI-simulations and a simulation of hearing loss. It is shown that localization performance can be improved by up to 14 degrees RMS error by artificially amplifying ILD cues in the low frequencies.

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[1] Francart T, Brokx J, Wouters J., Sensitivity to interaural level difference and loudness growth with bilateral bimodal stimulation. Audiol Neurotol 2008;13:309-319

[2] Francart T, Brokx J, Wouters J., Sensitivity to interaural time differences with combined cochlear implant and acoustic stimulation. J Assoc Res Otolaryngol. 2009 Mar;10(1):131-41